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Agency

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November 1990

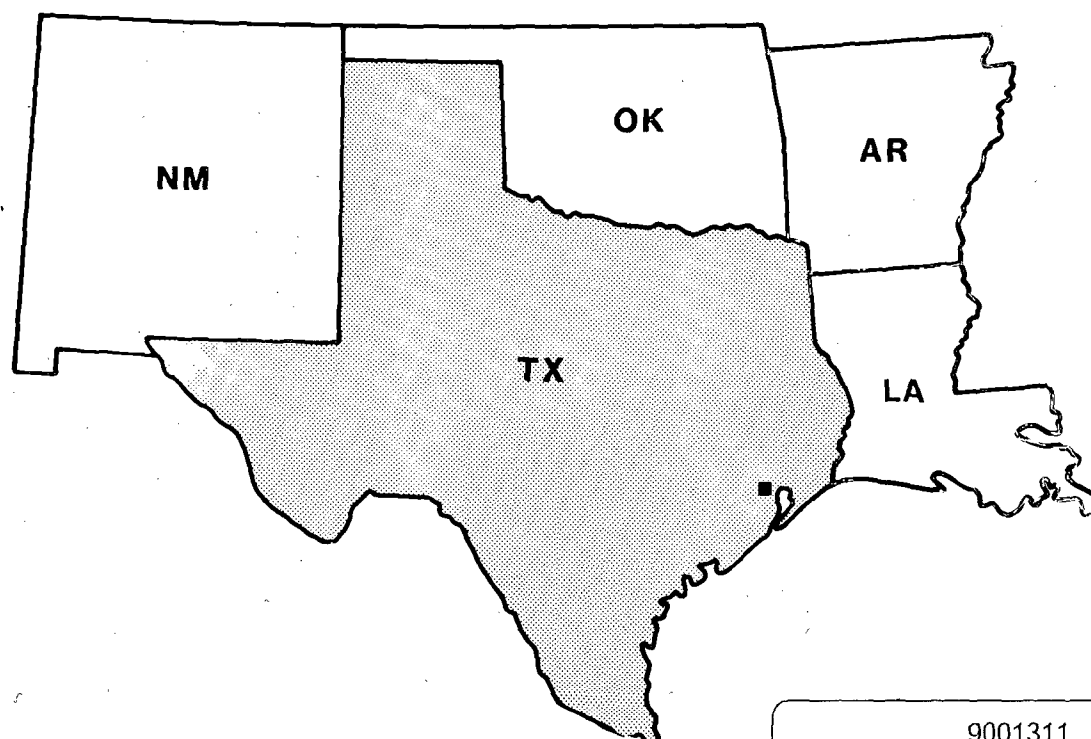
Research and Development



AERIAL PHOTOGRAPHIC ANALYSIS OF SHELL CHEMICAL - DEER PARK MANUFACTURING COMPLEX

Deer Park, Texas

EPA Region 6



9001311



TS-PIC-90783/91783
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AERIAL PHOTOGRAPHIC ANALYSIS OF SHELL CHEMICAL-DEER PARK
MANUFACTURING COMPLEX

Deer Park, Texas

by

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Contract No. 68-CO-0050

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ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
LAS VEGAS, NEVADA 89193-3478

NOTICE

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ABSTRACT

This report presents an intensive analysis of the Shell Chemical-Deer Park Manufacturing Complex, which is located in Deer Park, Texas. This analysis was performed to document the physical conditions and potential environmental hazards at this site through time. Three selected dates of black-and-white panchromatic, color infrared and current conventional color aerial photography were used to perform the analysis. This photography was acquired over a 10-year period (1981-1990).

The 1981 photos show the study area and the northern portion of Deer Park. The photos show approximately 1,500 vertical and 150 horizontal storage tanks in the study area. Scattered across the study area are 79 liquid impoundments and 29 areas of ground disturbances. Overall the study area contained the following: 6 storage areas, 2 substations, 11 water treatment facilities, 5 areas of dumping, 11 outfall points, 4 waste disposal areas, 2 sand and gravel operations, and 6 ship loading operations. The 1989 photos cover approximately the same area as in 1981. The scale and the appearance of the photography made interpretation difficult on this year. The photos show approximately 1,700 vertical and 180 horizontal storage tanks in the study area. Dispersed in the study area were 63 liquid impoundments and 36 areas of ground disturbances. Overall, in 1989, the study area contained the following: 10 storage areas, 2 substations, 11 water treatment facilities, 19 areas with dumping, 13 outfall points, 6 waste disposal areas, 2 sand and gravel operations, and 7 ship loading facilities. The 1990 photos provided the best opportunity for analysis. These photos covered a slightly larger area than the previous years did. These photos show approximately 2,400 vertical and 270 horizontal storage tanks. Dispersed in the study area were 108 liquid impoundments and 51 ground disturbances. Overall the study area contained the following: 37 storage areas, 7 substations, 14 water treatment facilities, 30 dumping areas, 13 outfall points, 2 waste disposal areas, 2 sand and gravel operations, and 10 ship loading facilities. Areas where the burial of barrels and other waste material have been identified on the photo. The amount of staining visible on all the years of photography was significant. There were many smaller stains visible that were too small to annotate on the photo overlays. The staining was evident in nearly every part of the facility.

The U.S. Environmental Protection Agency's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, prepared this report for the Agency's Environmental Services Division in Region 6 at Dallas, Texas and the Office of Emergency and Remedial Response in Washington, D.C.

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Figure 1. Site location map, Texas. Scale 1:5,200,000.

INTRODUCTION

This report presents an intensive analysis of the Shell Chemical-Deer Park Manufacturing Complex, which is located in Deer Park, Texas (Figure 1). This analysis was performed to document the physical conditions and potential environmental hazards at this site through time. Three selected dates of black-and-white panchromatic, color infrared, and current conventional color photography were used to perform this analysis. This photography was acquired over a 10-year period (1981-1990).

The Environmental Protection Agency's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, prepared this report for the Agency's Environmental Services Division in Region 6 at Dallas, Texas and the Office of Emergency and Remedial Response in Washington, D.C.

METHODOLOGY

Stereoscopic pairs of historical and current aerial photographs were used to perform the analysis. Stereo viewing enhances the interpretation because it allows the analyst to observe the vertical as well as horizontal spatial relationships of natural and cultural features. Stereoscopy is also an aid in distinguishing between various shapes, tones, textures, and colors that can be found within the study area.

Evidence of waste burial is a prime consideration when conducting a hazardous waste analysis. Leachate or seepage resulting from burial and dumping of hazardous materials might threaten existing surface or ground-water sources. Pools of unexplained liquid are routinely noted because they can indicate seepage from buried wastes that may enter drainage channels and allow contaminants to move off the site. An excellent indicator of how hazardous materials are being handled at a site is the presence or absence of spills, spill stains, and vegetation damage. Trees and other forms of vegetation that exhibit a marked color difference from surrounding members of the same species are labeled "dead," "stressed," or "damaged," based upon the degree of noticeable variation. Vegetation is so labeled only after consideration of the season in which the photographs were acquired.

The U.S. Environmental Protection Agency's Statement of Procedures on Floodplain Management and Wetlands Protection (Executive Orders 11988 and 11990, respectively) requires EPA to determine if removal or remedial actions at hazardous waste sites will affect wetlands or floodplains and to avoid or minimize adverse impacts on those areas. To aid in compliance with these orders, significant wetland areas located within and adjacent to the sites have been identified and delineated. However, the sites have not been visited to verify the accuracy of wetland identification.

Drainage analysis determines the direction a spill or surface runoff would follow. Direction of drainage is determined from analysis of the photographs and from U.S. Geological Survey topographic maps. Whenever they are available, 7.5-minute quadrangle maps (scale 1:24,000) are used to show site location and to provide geographic and topographic information. The site boundary as depicted on Figure 2 was selected by the analyst, and is not intended to be used as legal boundaries.

Results of the analysis are shown on annotated overlays attached to the photos. The following table provides documentation of the photographs used in this report:

TABLE 1. DOCUMENTATION OF AERIAL PHOTOGRAPHY

Site name, location, geographic coordinates, and SSID#	Figures	Date of acquisition	Original scale	Film type†	Photo source‡	Photo I.D.	Frames
Shell Chemical-Deer	3	08-26-90	1:25,500	CC	EMSL	90783	5
Park Manufacturing	4-7	11-04-81	1:40,000	B&W	ASCS	48201	196,197
Complex	8,11	03-23-89	1:40,000	CIR	EROS	NAPP	145,146
Deer Park, TX	9-10	03-09-89	1:40,000	CIR	EROS	NAPP	206,207
29°43'43"N	12-18	08-26-90	1:12,900	CC	EMSL	90783	12,14,19
095°07'24"W							21,23,27
SSID# unlisted							29

†Film type identification:

CC: Conventional Color

B&W: Black-and-White

CIR: Color Infrared

‡Photo source identification:

EMSL: U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

ASCS: U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Salt Lake City, Utah.

EROS: U.S. Department of the Interior, Geological Survey, Earth Resources Observation Systems Data Center, Sioux Falls, South Dakota.

ANALYSIS SUMMARY

The Shell Chemical-Deer Park Manufacturing Complex (DPMC) study area is located in the city of Deer Park, Texas. The study area occupies approximately 6,370 acres (Figure 2). The major drainages are the Boggy Bayou, the Patrick Bayou and Tucker Bayou. The direction of flow for these and other drainages is northward. All these flow into Buffalo Bayou which flows into Galveston Bay and then into the Gulf of Mexico. The major portion of the drainage in the study area was underground by the use of storm drains and sewers. The overland drainage was only visible in a few areas. Many sites were identified where waste or treated water was entering one of the drainages. The study area is relatively flat. There is a system of levees along the bayous but this site would be susceptible to a 100-year flood event.

The 1981 photos (Figures 4-7) show the study area and the northern portion of Deer Park. The photos show approximately 1,500 vertical and 150 horizontal storage tanks in the study area. Scattered across the study area are 79 liquid impoundments and 29 areas of ground disturbances. Overall the study area contained the following: 6 storage areas, 2 substations, 11 water treatment facilities, 5 areas of dumping, 11 outfall points, 4 waste disposal areas, 2 sand and gravel operations, and 6 ship loading operations. The 1989 photos (Figures 8-11) cover approximately the same area as in 1981. The scale and the appearance of the photography made interpretation difficult on this year. The photos show approximately 1,700 vertical and 180 horizontal storage tanks in the study area. Dispersed in the study area were 63 liquid impoundments and 36 areas of ground disturbances. Overall, in 1989, the study area contained the following: 10 storage areas, 2 substations, 11 water treatment facilities, 19 areas with dumping, 13 outfall points, 6 waste disposal areas, 2 sand and gravel operations, and 7 ship loading facilities. The 1990 photos (Figures 3, 12-18) provided the best opportunity for analysis. These photos covered a slightly larger area than the previous years did. These photos show approximately 2,400 vertical and 270 horizontal storage tanks. Dispersed in the study area were 108 liquid impoundments and 51 ground disturbances. Overall the study area contained the following: 37 storage areas, 7 substations, 14 water treatment facilities, 30 dumping areas, 13 outfall points, 2 waste disposal areas, 2 sand and gravel operations, and 10 ship loading facilities. Areas where the burial of barrels and other waste material have been identified on the photo. The amount of staining visible on all the years of photography was significant. There were many smaller stains visible that were too small to annotate on the photo overlays. The staining was evident in nearly every part of the facility.

PHOTO ANALYSIS

AUGUST 26, 1990 (FIGURE 3)

This conventional color photograph shows the study area in relation to the surrounding area. Shown on the overlays are the photo coverage indices, showing the approximate extent of the photographs used in this report.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- X-X-X-X FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- X X X X X FENCE
- STUDY AREA

DRAINAGE

- DRAINAGE
- ← FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + RAILWAY

SITE FEATURES

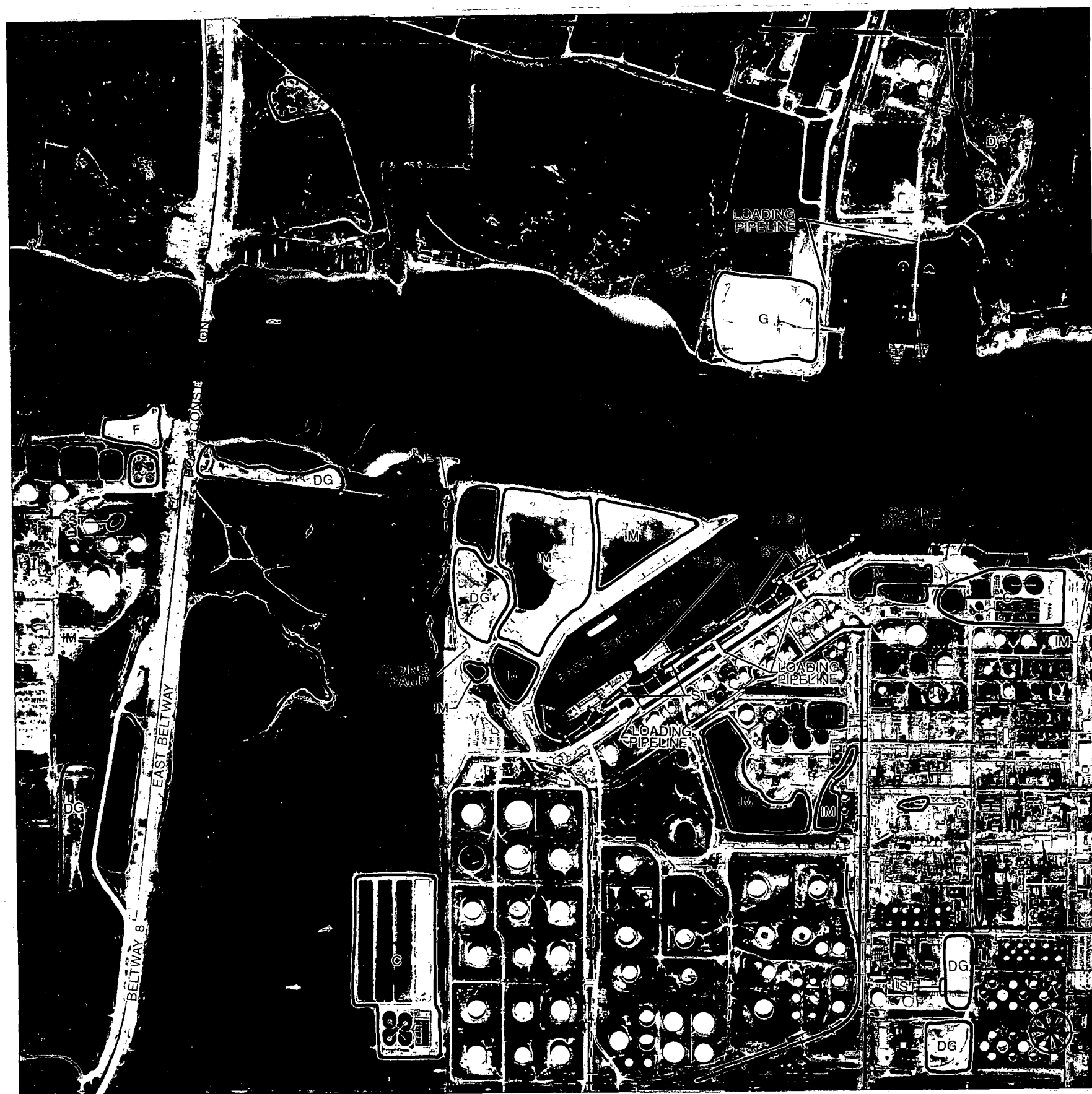
- ||||| DIKE
- SL STANDING LIQUID
- SL STANDING LIQUID
- ⊖ EXCAVATION, PIT (EXTENSIVE)
- ⊖ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 3. Shell Chemical-Deer Park Manufacturing Complex, August 26, 1990.
Approximate scale 1:25,500.

NOVEMBER 4, 1981 (FIGURE 4)

This photo covers the northwest quadrant of the study area. In this area all the storage tanks are adequately contained by berms. Several areas of staining are visible. There are 19 liquid impoundments visible in this photo. Six areas have been noted as ground disturbances. The East Beltway 8 is under construction in the western half of the photo. Other significant features are described below.

Annotation	Description
C	This annotation denotes a water treatment facility, there are three noted on the photo.
E	These are locations where an outfall is emptying into another drainage.
F	This is a possible waste disposal area.
G	This is a sand and gravel operation.
H-2	This ship loading/unloading facility handles petroleum coke, crude oil, petroleum products, and chemicals.
H-3	This ship loading/unloading facility handles petroleum coke, crude oil, petroleum products, vegetable oils, tallow, animal fats, sand, gravel, stone, cement, phosphate rock and aragonite.



INTERPRETATION CODE	
BOUNDARIES AND LIMITS	
X-X-X-X	FENCED SITE BOUNDARY
---	UNFENCED SITE BOUNDARY
X X X X X	FENCE
---	STUDY AREA
DRAINAGE	
---	DRAINAGE
→	FLOW DIRECTION
---	INDETERMINATE DRAINAGE
TRANSPORTATION/UTILITY	
=====	VEHICLE ACCESS
+++++	RAILWAY
SITE FEATURES	
	DIKE
SL	STANDING LIQUID
SL	STANDING LIQUID
⊖	EXCAVATION, PIT (EXTENSIVE)
⊖	MOUNDED MATERIAL (EXTENSIVE)
MM	MOUNDED MATERIAL (SMALL)
CR	CRATES/BOXES
DR	DRUMS
HT	HORIZONTAL TANK
PT	PRESSURE TANK
VT	VERTICAL TANK
CA	CLEARED AREA
DG	DISTURBED GROUND
FL	FILL
IM	IMPOUNDMENT
LG	LAGOON
OF	OUTFALL
SD	SLUDGE
ST	STAIN
SW	SOLID WASTE
TR	TRENCH
VS	VEGETATION STRESS
WD	WASTE DISPOSAL AREA
WL	WETLAND

Figure 4. Shell Chemical-Deer Park Manufacturing Complex, November 4, 1981.
Approximate scale 1:11,000.

NOVEMBER 4, 1981 (FIGURE 5)

This photo covers the northeast quadrant of the study area. The storage tanks in this photo all have adequate containment. Several areas of staining are noted on the photo. Forty-three liquid impoundments are visible on this photo. Thirteen areas have been noted as ground disturbances. Several areas of mounded material are noted. Of special interest is the large outfall plume going into Patrick Bayou, and the liquid impoundment with a breached wall that also emptied into Patrick Bayou. Other significant features are described below.

Annotation	Description
A	Three storage areas containing various equipment for the facility, and also some stains and ground disturbances.
C	Three water treatment facilities are visible on this photo.
D	These are areas where dumping of waste or refuse is occurring.
E	Six areas of outfall have been noted on this photo.
F	This is a possible waste disposal area.
H-5	This ship loading/unloading facility handles containerized cargo, heavy material and equipment.
H-6	This ship loading/unloading facility handles heavy materials and equipment, chemicals, and petrochemicals.
H-7	This ship loading/unloading facility handles molasses, fertilizer, grain, and bulk cement.
H-9	This ship loading/unloading facility handles steel and fabricated steel products.



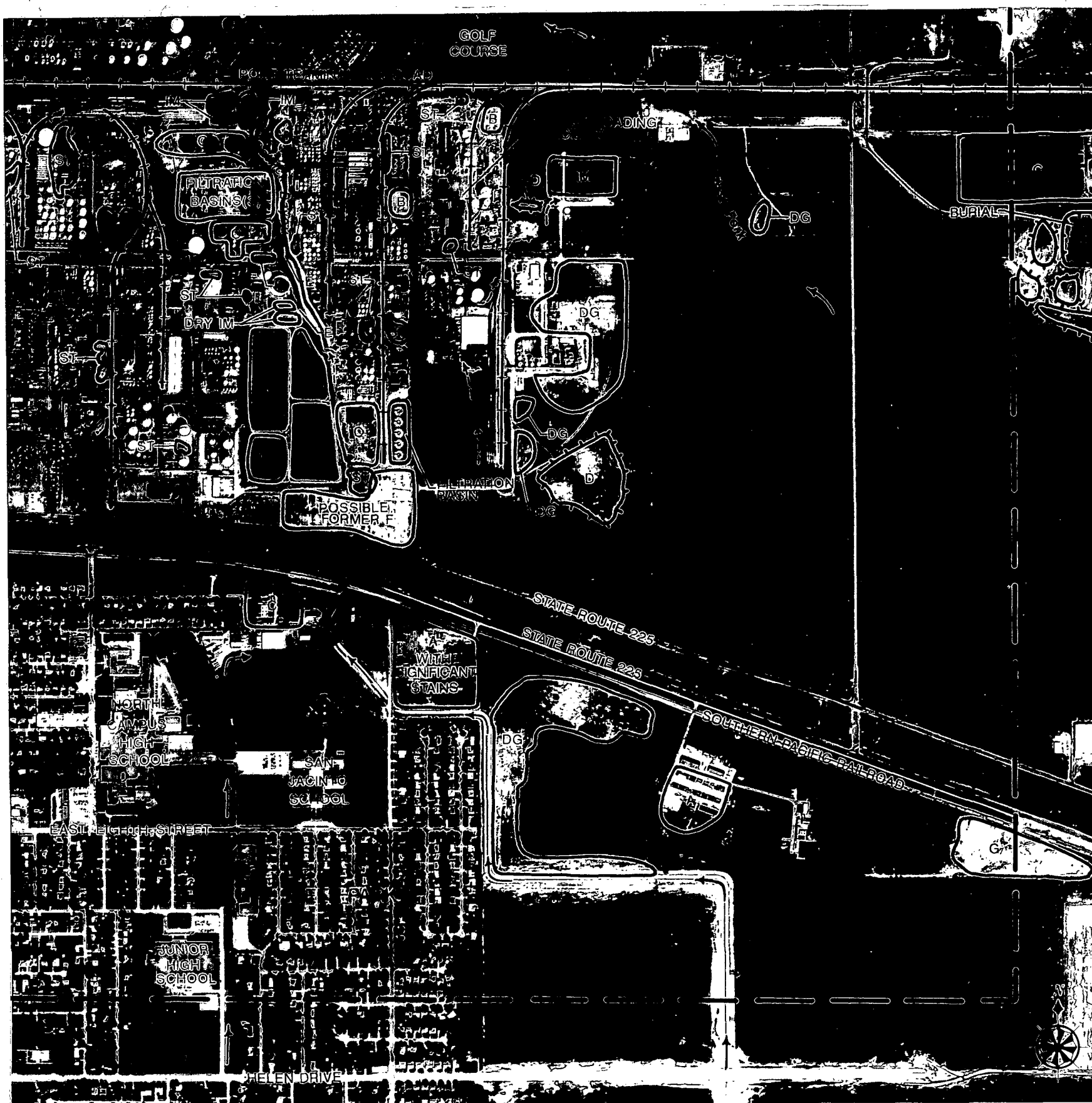
INTERPRETATION CODE	
BOUNDARIES AND LIMITS	
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—	UNFENCED SITE BOUNDARY
X X X X X	FENCE
---	STUDY AREA
DRAINAGE	
---	DRAINAGE
→	FLOW DIRECTION
---	INDETERMINATE DRAINAGE
TRANSPORTATION/UTILITY	
=====	VEHICLE ACCESS
+++++	RAILWAY
SITE FEATURES	
	DIKE
SL	STANDING LIQUID
SL	STANDING LIQUID
○	EXCAVATION, PIT (EXTENSIVE)
○	MOUNDED MATERIAL (EXTENSIVE)
MM	MOUNDED MATERIAL (SMALL)
CR	CRATES/BOXES
DR	DRUMS
HT	HORIZONTAL TANK
PT	PRESSURE TANK
VT	VERTICAL TANK
CA	CLEARED AREA
DG	DISTURBED GROUND
FL	FILL
IM	IMPOUNDMENT
LG	LAGOON
OF	OUTFALL
SD	SLUDGE
ST	STAIN
SW	SOLID WASTE
TR	TRENCH
VS	VEGETATION STRESS
WD	WASTE DISPOSAL AREA
WL	WETLAND

Figure 5. Shell Chemical-Deer Park Manufacturing Complex, November 4, 1981.
Approximate scale 1:11,000.

NOVEMBER 4, 1981 (FIGURE 6)

This photo covers the southeast quadrant of the study area. In this area all the storage tanks are adequately contained. There are several areas of staining visible throughout the study area. Five areas of ground disturbances and 15 liquid impoundments have been noted. The northern part of the city of Deer Park is visible, and three schools are shown in relation to the site. A facility used for the loading of tanker trucks is located in the site. Some stains are visible at this facility. Burial activity is visible in the easternmost section of this photo, it appears that liquid waste is being disposed of in this area. Other significant features are described below.

Annotation	Description
A	These are two storage areas that contain various construction materials. Significant staining is noted within one of the areas.
B	These are two power substations.
C	These are five water treatment facilities located in the study area.
D	These are two areas of dumping and liquid waste is possibly being buried in the eastern area.
E	These are two areas of outfall going into Patrick Bayou.
F	This is a possible former waste disposal area.
G	This is a sand and gravel operation that is supported by the Southern Pacific Railroad with a railcar loading/unloading facility.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- X-X-X-X FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- XXXXXX FENCE
- STUDY AREA

DRAINAGE

- DRAINAGE
- FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- VEHICLE ACCESS
- RAILWAY

SITE FEATURES

- DIKE
- STANDING LIQUID
- SL STANDING LIQUID
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 6. Shell Chemical-Deer Park Manufacturing Complex, November 4, 1981.
Approximate scale 1:11,000.

NOVEMBER 4, 1981 (FIGURE 7)

This photo covers the southwest quadrant of the study area. All storage tanks visible in this photo are adequately contained. There are areas of staining visible on this photo. Two liquid impoundments are located in this quadrant, and five areas of ground disturbances are also visible. Large areas of mounded materials are seen in this photo, all of which are located in a waste disposal area. Other significant features are described below.

Annotation	Description
A	One storage area containing various materials for the facility and some stains.
D	This is one small area of dumping.
F	This is a large waste disposal area with large areas of mounded materials, ground disturbances, 2 impoundments, and 64 trenches are located in this waste disposal area.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- X—X—X—X—X— FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- X X X X X X FENCE
- — — — — STUDY AREA

DRAINAGE

- — — — — DRAINAGE
- — — — — FLOW DIRECTION
- — — — — INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- +++++ RAILWAY

SITE FEATURES

- ||||| DIKE
- SL STANDING LIQUID
- SL STANDING LIQUID
- ⬭ EXCAVATION, PIT (EXTENSIVE)
- ⬭ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 7. Shell Chemical-Deer Park Manufacturing Complex, November 4, 1981.
Approximate scale 1:11,000.

MARCH 23, 1989 (FIGURE 8)

This color infrared photograph covers the northwest quadrant of the study area, and roughly corresponds to the 1981 photo in Figure 4. The storage tanks all appear to be adequately contained. Areas of staining have been noted in the site. There are 14 liquid impoundments located on this area. Thirteen areas of ground disturbances are also noted. The East Beltway 8 road construction has been completed since 1981. An area of mounded material is located in the ship loading facility on the north side of Buffalo Bayou. The northern wall of the large dry impoundment, southwest of Boggy Bayou Basin, has been breached. Spillage from this impoundment was able to reach Buffalo Bayou. Two areas of new construction have been added since 1981 to the site. Other significant features are described below.

Annotation	Description
C	Three water treatment facilities are visible in this quadrant.
D	These are six areas of dumping. The dumping to the west of the Boggy Bayou Basin is especially significant.
E	These are four liquid outfalls going into Buffalo Bayou.
F	This is a possible waste disposal area.
G	This is a sand and gravel operation.
H-2	This ship loading/unloading facility handles petroleum coke, crude oil, petroleum products and chemicals.
H-3	This ship loading/unloading facility handles petroleum coke, crude oil, petroleum products, chemicals, vegetable oils, tallow, animal fats, sand, gravel, stone, cement, phosphate rock, and aragonite.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x FENCE
- STUDY AREA

DRAINAGE

- DRAINAGE
- FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ==== VEHICLE ACCESS
- + + + + RAILWAY

SITE FEATURES

- ||||| DIKE
- SL STANDING LIQUID
- SL STANDING LIQUID
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 8. Shell Chemical-Deer Park Manufacturing Complex, March 23, 1989.
Approximate scale 1:10,800.

MARCH 9, 1989 (FIGURE 9)

This photo covers the northeast quadrant of the study area. This photo roughly corresponds to Figure 5. The storage tanks appear to be adequately contained. Stains are visible in several areas of the facility. There are 32 liquid impoundments visible on this photo, as well as 12 areas of ground disturbances. There is a significant outfall plume visible in Patrick Bayou. Areas of mounded materials are also visible. The large area of mounded material on the west side of Patrick Bayou was being used in 1981 as a dumping area and has since been covered over with fill material. One impoundment that borders Patrick Bayou has been noted as possibly having a breached wall allowing its contents to flow into Patrick Bayou. A liquid impoundment has been filled in since 1981; it is located east of the filtration basins. Other significant features are described below.

Annotation	Description
A	These are three storage areas.
C	These are three water treatment facilities.
D	These are five areas where dumping has occurred.
E	These are seven areas where an outfall has been noted.
F	This is a waste disposal area.
H-4	This is a ship mooring.
H-5	This ship loading/unloading facility handles heavy material and equipment and containerized cargo.
H-6	This ship loading/unloading facility handles petrochemicals, chemicals, and heavy materials and equipment.
H-7	This ship loading/unloading facility handles bulk cement, molasses, fertilizer, and grain.
H-9	This ship loading/unloading facility handles steel and fabricated steel products.
H-10	This ship loading/unloading facility handles petrochemicals and chemicals.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- x-x-x-x-x FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- x x x x x x FENCE
- STUDY AREA

DRAINAGE

- DRAINAGE
- ← FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- +++++ RAILWAY

SITE FEATURES

- ||||| DIKE
- SL STANDING LIQUID
- SL STANDING LIQUID
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 9. Shell Chemical-Deer Park Manufacturing Complex, March 9, 1989.
Approximate scale 1:10,800.

MARCH 9, 1989 (FIGURE 10)

This photo covers the southeast quadrant of the study area. It roughly corresponds to Figure 6. All the storage tanks in this photo are adequately contained. Staining is visible in several areas. There are 17 liquid impoundments, and 8 areas of ground disturbances visible. Three vertical storage tanks have been removed since 1981. Six vertical storage tanks have been added since 1981. An area that is storing barrels has been noted. A facility used for the loading of trucks has also been noted. The northern part of Deer Park is visible, and three schools were identified in the study area. Three areas that have had new construction since 1981 were noted. An area that had two impoundments in 1981 was filled in and a new vertical storage tank was built on that site. Other significant features are described below.

Annotation	Description
A	These are two storage areas that contain various construction material, and some staining. One has a possible filled trench.
B	These are power substations.
C	These are five water treatment facilities.
D	These are two areas where dumping is occurring.
E	There are two areas where there is an outfall source going into Patrick Bayou.
F	These are areas that are possibly being used as waste disposal areas.
G	This is a sand and gravel operation with a facility for loading and unloading railcars, and is supported by the Southern Pacific Railroad.

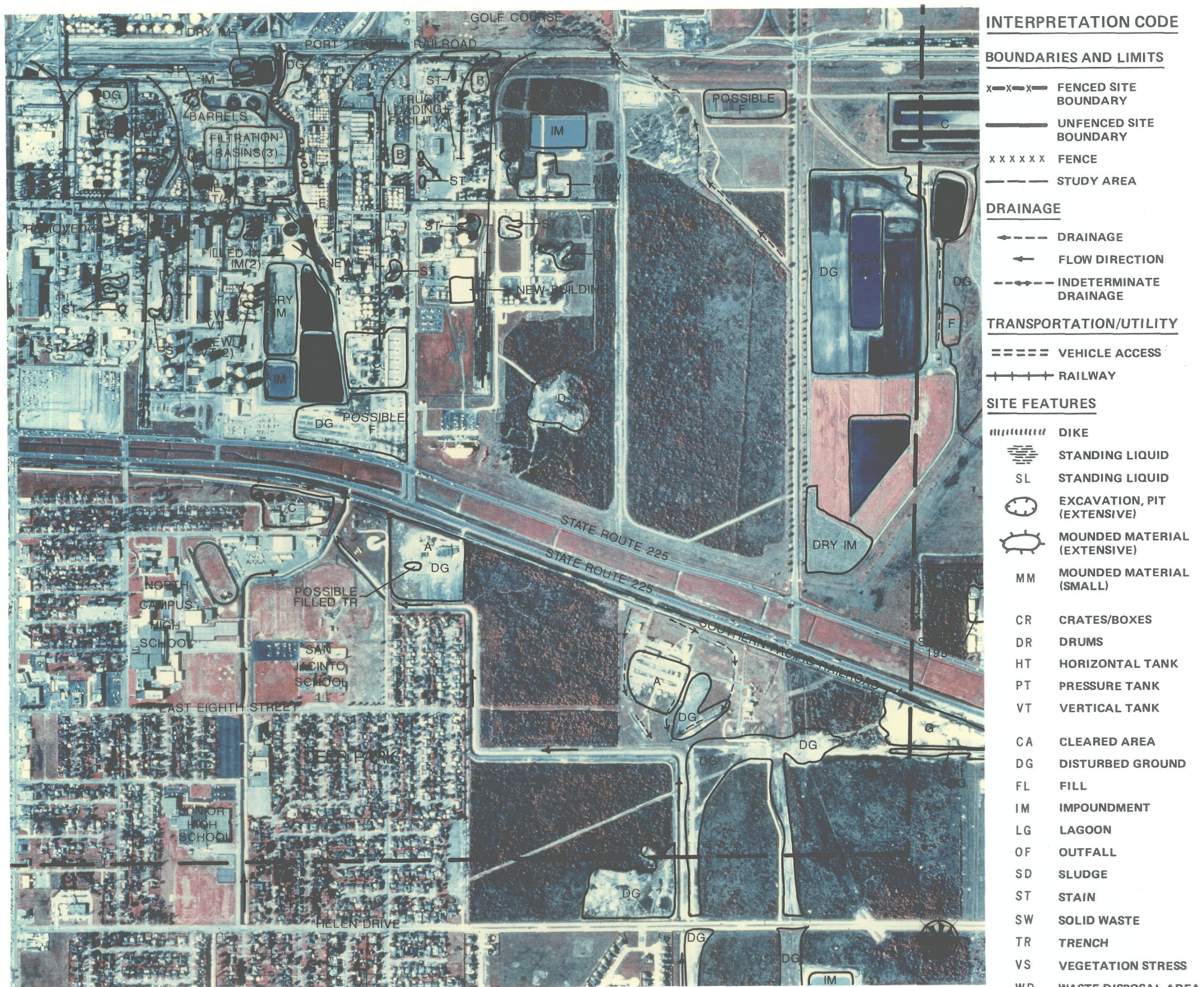


Figure 10. Shell Chemical-Deer Park Manufacturing Complex, March 9, 1989. Approximate scale 1:10,800.

MARCH 23, 1989 (FIGURE 11)

This photo covers the southwest portion of the study area, and roughly corresponds to Figure 7. The storage tanks in the photo all have adequate containment. Staining is visible in many areas. Three areas of ground disturbances have been noted and no liquid impoundments were identified. In the area marked as the waste disposal area significant dumping is noted. The trenches visible in 1981 are mostly filled in and starting to be covered over. Large mounds of possible waste material are also visible in the waste disposal area. Other significant features are described below.

Annotation	Description
A	These are three storage areas.
D	Dumping has occurred in these six areas.
F	This is a waste disposal area, and was described above.

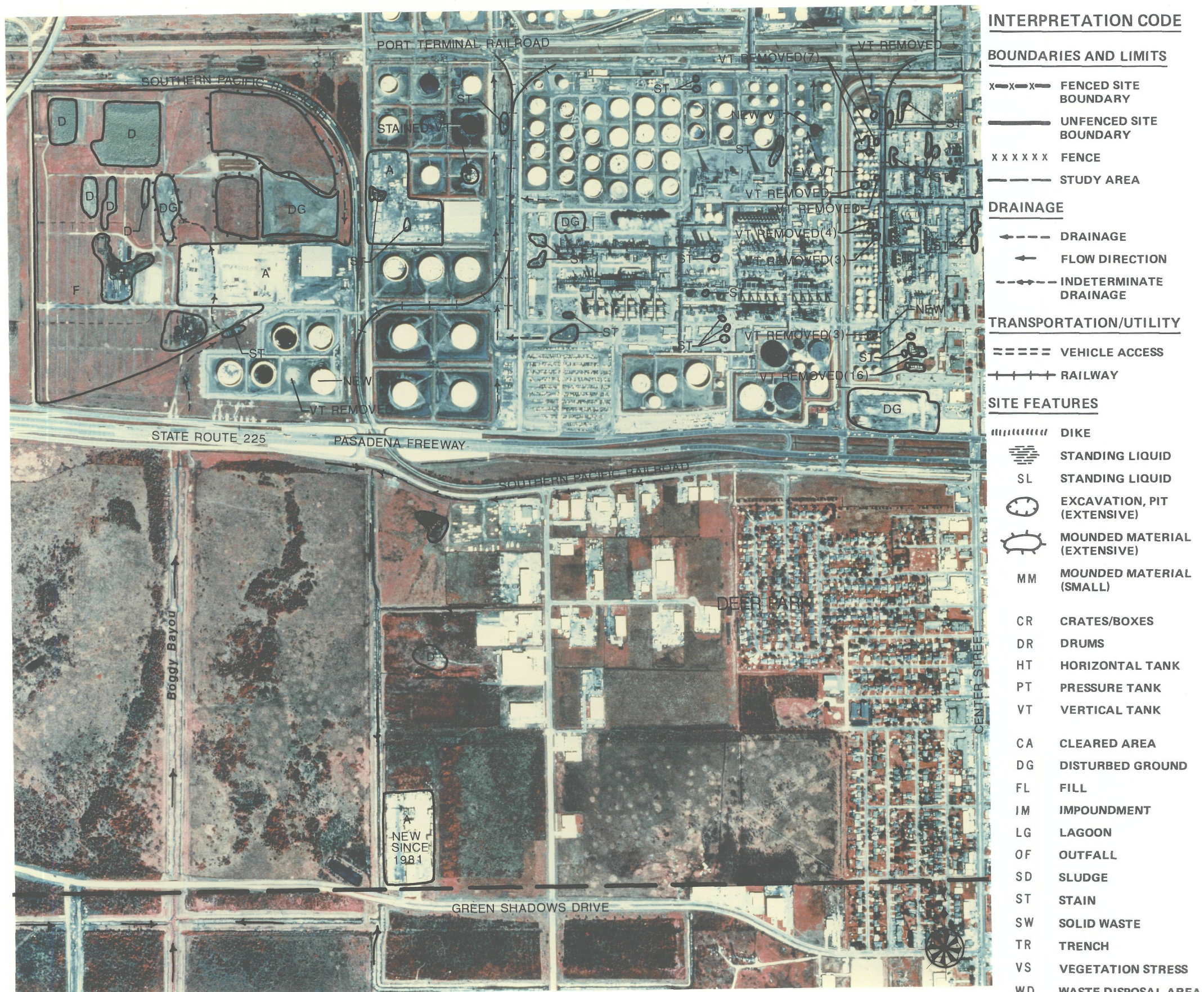


Figure 11. Shell Chemical-Deer Park Manufacturing Complex, March 23, 1989.
Approximate scale 1:10,800.

AUGUST 26, 1990 (FIGURE 12)

This photo covers an area covered in Figures 5 and 9. The storage tanks in this area are adequately contained. Areas of stains are visible throughout the facility. A significant outfall plume is visible in Patrick Bayou. This plume was also visible in the previous years of photography. There are several areas of mounded material in various locations. Most of these mounds appear to be associated with a rail or a port facility. Two impoundments are filled in or are being filled in on this photo. Nine areas of ground disturbances have been noted, as well as 32 liquid impoundments. Other significant features are described below.

Annotation	Description
A	These are 16 storage areas, with a wide variety of materials and equipment, and in many of these areas there are large stains.
B	This is a power substation.
C	These are two water treatment facilities.
D	These are four areas where dumping has been occurring.
E	Seven points of discharge are noted on the photo.
H-2	This ship loading/unloading facility handles petroleum coke, crude oil, petroleum products, and chemicals.
H-3	This ship loading/unloading facility handles petroleum coke, crude oil, petroleum products, vegetable oil, tallow, animal fats, sand, gravel, stone, cement, phosphate rock, and aragonite.
H-4	This is used for the mooring of towboats.
H-5	This ship loading/unloading facility handles heavy material and equipment, and containerized cargo.
H-6	This ship loading/unloading facility handles petrochemicals, chemicals, heavy material, and equipment.
H-7	This ship loading/unloading facility handles grain, molasses, and fertilizer.
H-8	This ship loading/unloading facility handles steel and fabricated steel products.
H-9	This ship loading/unloading facility handles steel and fabricated steel products.



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- X-X-X-X FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- X X X X X X FENCE
- STUDY AREA

DRAINAGE

- DRAINAGE
- FLOW DIRECTION
- INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- +++++ RAILWAY

SITE FEATURES

- ||||| DIKE
- SL STANDING LIQUID
- SL STANDING LIQUID
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 12. Shell Chemical-Deer Park Manufacturing Complex, August 26, 1990. Approximate scale 1:12,900.

AUGUST 26, 1990 (FIGURE 13)

This photo covers approximately the same area that Figures 4 and 8 did. There is staining visible in several areas. All the storage tanks in this photo are adequately contained. Four areas of ground disturbances and 21 impoundments have been noted. Other significant features are described below.

Annotation	Description
A	These are four storage areas.
C	This is a water treatment facility.
D	Dumping has been occurring in these seven areas.
E	These are two areas of discharge into Buffalo Bayou.
G	This is a sand and gravel operation.
H-1	This ship loading/unloading facility handles chemicals and petrochemicals.
H-2	This ship loading/unloading facility handles petroleum coke, crude oil, petroleum products and chemicals.

AUGUST 26, 1990 (FIGURE 14)

This photo covers an area that was previously looked at in earlier photography covered in Figures 4, 5, 8, and 11. All the storage tanks in this photo are adequately contained. There is staining visible in many areas. Nine liquid impoundments and 3 areas of ground disturbances are visible. Near the waste disposal area are several large mounds of possibly waste material. The trenches that were visible in the previous years have for the most part been filled in and covered over. In the 1989 photography extensive areas of dumping were seen in this area. Since then the material that had been dumped there has been removed, leaving only ground scars. Other significant features are listed below.

Annotation

Description

- | | |
|---|---|
| A | These are four storage areas. |
| C | This is a water treatment facility. |
| D | This area has been used for dumping. |
| E | This is a discharge pipe going into a small drainage. |
| F | These are two waste disposal areas. |



INTERPRETATION CODE

BOUNDARIES AND LIMITS

- X—X—X—X—X— FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- X X X X X X FENCE
- — — — — STUDY AREA

DRAINAGE

- — — — — DRAINAGE
- — — — — FLOW DIRECTION
- — — — — INDETERMINATE DRAINAGE

TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- +++++ RAILWAY

SITE FEATURES

- ||||| DIKE
- SL STANDING LIQUID
- SL STANDING LIQUID
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 14. Shell Chemical-Deer Park Manufacturing Complex, August 26, 1990.
Approximate scale 1:12,900.

AUGUST 26, 1990 (FIGURE 15)

This photo covers areas that were discussed earlier in Figures 5, 6, 9, and 10. All the storage tanks in this photo are adequately contained. Staining is visible in many areas. There are a significant amount of barrels being stored in one location marked on the photo. Some staining is visible with the barrels. Eleven liquid impoundments and 12 areas of ground disturbances have been noted. A small horizontal storage tank has been noted as leaking. There is some ground staining as a result of this. Other significant features are described below.

Annotation	Description
A	These are five storage areas.
B	These are four power substations.
C	These are three water treatment facilities.
D	These seven areas have been used for dumping.
E	These are three areas of liquid outfall into Patrick Bayou.



INTERPRETATION CODE	
BOUNDARIES AND LIMITS	
X-X-X-X	FENCED SITE BOUNDARY
————	UNFENCED SITE BOUNDARY
X X X X X X	FENCE
-----	STUDY AREA
DRAINAGE	
----->	DRAINAGE
----->	FLOW DIRECTION
-----<-----	INDETERMINATE DRAINAGE
TRANSPORTATION/UTILITY	
=====	VEHICLE ACCESS
+++++	RAILWAY
SITE FEATURES	
	DIKE
~~~~~	STANDING LIQUID
SL	STANDING LIQUID
⊖	EXCAVATION, PIT (EXTENSIVE)
⊕	MOUNDED MATERIAL (EXTENSIVE)
MM	MOUNDED MATERIAL (SMALL)
CR	CRATES/BOXES
DR	DRUMS
HT	HORIZONTAL TANK
PT	PRESSURE TANK
VT	VERTICAL TANK
CA	CLEARED AREA
DG	DISTURBED GROUND
FL	FILL
IM	IMPOUNDMENT
LG	LAGOON
OF	OUTFALL
SD	SLUDGE
ST	STAIN
SW	SOLID WASTE
TR	TRENCH
VS	VEGETATION STRESS
WD	WASTE DISPOSAL AREA
WL	WETLAND

Figure 15. Shell Chemical-Deer Park Manufacturing Complex, August 26, 1990. Approximate scale 1:12,900.



AUGUST 26, 1990 (FIGURE 16)

This photo covers areas that were previously discussed on Figures 5, 6, 9, and 10. All the tanks in this photo are adequately contained. Staining is visible in many areas. Eleven tanks were removed, leaving ground scars where the tanks were. The mounded material that is located in the waste disposal area is associated with burial activity in the site. Barrels are visible in the northern pit in the waste disposal area. This pit is actively disposing of waste. The southern pit appears to still be being prepared to receive waste. The large mounded area was in the past used as a burial site and has since been covered over. In the same area were several liquid impoundments but they have also been covered over. There are 29 liquid impoundments and 15 areas of ground disturbances visible. Seven areas are identified that are being used as barrel storage. Other significant features are described below.

Annotation

Description

- |   |                                                          |
|---|----------------------------------------------------------|
| A | These are seven storage areas.                           |
| B | These are two power substations.                         |
| C | These are four water treatment facilities.               |
| D | These nine areas have been used for dumping.             |
| F | This is a waste disposal area and was discussed earlier. |





# INTERPRETATION CODE

## BOUNDARIES AND LIMITS

- X-X-X-X FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- X X X X X FENCE
- STUDY AREA

## DRAINAGE

- DRAINAGE
- FLOW DIRECTION
- INDETERMINATE DRAINAGE

## TRANSPORTATION/UTILITY

- VEHICLE ACCESS
- RAILWAY

## SITE FEATURES

- DIKE
- STANDING LIQUID
- SL STANDING LIQUID
- EXCAVATION, PIT (EXTENSIVE)
- MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 16. Shell Chemical-Deer Park Manufacturing Complex, August 26, 1990.  
Approximate scale 1:12,900.



AUGUST 26, 1990 (FIGURE 17)

This photo covers an area that was previously discussed in Figures 6 and 10. No liquid impoundments were visible but one area of ground disturbance is located on this photo. Staining is visible in the sand and gravel operation. The northern area of Deer Park is shown as are three schools that are within the study area. Other significant features are described below.

Annotation	Description
A	This is a storage area.
C	These are two water treatment facilities.
G	This is a sand and gravel operation with a railcar loading area and is supported by the Southern Pacific Railroad.





# INTERPRETATION CODE

## BOUNDARIES AND LIMITS

- X-X-X-X FENCED SITE BOUNDARY
- UNFENCED SITE BOUNDARY
- X X X X X FENCE
- - - STUDY AREA

## DRAINAGE

- - - DRAINAGE
- FLOW DIRECTION
- - - INDETERMINATE DRAINAGE

## TRANSPORTATION/UTILITY

- ===== VEHICLE ACCESS
- + + + + RAILWAY

## SITE FEATURES

- ||||| DIKE
- SL STANDING LIQUID
- SL STANDING LIQUID
- ⊖ EXCAVATION, PIT (EXTENSIVE)
- ⊕ MOUNDED MATERIAL (EXTENSIVE)
- MM MOUNDED MATERIAL (SMALL)
- CR CRATES/BOXES
- DR DRUMS
- HT HORIZONTAL TANK
- PT PRESSURE TANK
- VT VERTICAL TANK
- CA CLEARED AREA
- DG DISTURBED GROUND
- FL FILL
- IM IMPOUNDMENT
- LG LAGOON
- OF OUTFALL
- SD SLUDGE
- ST STAIN
- SW SOLID WASTE
- TR TRENCH
- VS VEGETATION STRESS
- WD WASTE DISPOSAL AREA
- WL WETLAND

Figure 17. Shell Chemical-Deer Park Manufacturing Complex, August 26, 1990.  
Approximate scale 1:12,900.



AUGUST 26, 1990 (FIGURE 18)

This photo covers an area that was also discussed in Figures 7 and 11. Several stains are visible in this photo. Two liquid impoundments and three areas of ground disturbances are visible. A large borrow pit is visible on this photo. The northern part of Deer Park is part of this photo. Other significant features are described below.

Annotation

Description

A

This is a storage area.

D

These six areas have been used for dumping.



